

KANGAROO CARE IN THE NICU: A PRACTICE GUIDELINE

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Infants weighing less than 2500 grams at birth regardless of gestational age are considered low birthweight (LBW) infants (Conde-Aguedelo, Diaz-Rossello, & Belizan, 2003). These infants have a high mortality rate, and often have developmental problems. Every year, there are over 25 million LBW infants born, and most of them are born in developing countries, where they have an even greater morbidity and mortality risk (Conde-Aguedelo, Diaz-Rossello, & Belizan, 2003). In 1978, two physicians, Dr. Rey and Dr. Martinez, proposed and developed the kangaroo mother care (KMC) method at Instituto Materno Infantil in Bogotá, Colombia. This method was developed out of necessity, because the hospital wards for low birth weight infants were often overcrowded, and there were limited financial as well as human resources to care for these infants (Johnson, 2005). This method was developed as an alternative to the conventional method of care, in which infants are cared for inside an incubator by highly trained professionals. With the KMC method, the mothers are used as incubators and are the main source of food and stimulation for the LBW infants (Conde-Aguedelo, Diaz-Rossello, & Belizan, 2003).

Components of the Kangaroo Mother method of care include continuous skin-to-skin contact with the mother, exclusive or nearly exclusive breastfeeding, and early discharge from the hospital (Conde-Aguedelo, Diaz-Rossello, & Belizan, 2003). Skin-to-skin contact is initiated by placing the diaper-clad infant between the mother's breasts and under her clothes. The infant is held in a strictly upright position and remains in this position 24 hours a day with the exception of removal for diaper changes. Kangaroo

positioning is utilized to help regulate neonatal temperature and to facilitate mother-infant bonding.

Kangaroo nutrition is the delivery of nutrition to infants through breastfeeding, including direct sucking, as soon as oral feeding is possible (Charpak et al 2005). Upon initiation of breastfeeding, a strict schedule of feeding every two hours is followed to obtain a weight gain of 15-20 grams/kilogram/day, similar to the intrauterine weight gain during the third trimester. Once weight gain is considered adequate, the schedule may be relaxed to meet infant demands. Early home discharge is often a component of Kangaroo Care in developing countries. With early discharge, the infant may be either discharged home or to a Kangaroo Care Ward, in the Kangaroo Care position. However, early discharge is controversial, and if early discharge is attempted, there should be adequate follow-up and access to emergency care should be assured (Charpak et al., 2005).

Although Kangaroo Care is practiced frequently with stable low birthweight neonates in developing countries, the use in developed countries varies. In the United States, there is access to advanced neonatal care measures and conventional care, which is often not available in developing countries. With this advanced neonatal care, neonates who would not survive in developing countries are able to survive, and may achieve developmental milestones. However, this method of care may lead one to question whether this is sacrificing the abilities of the mothers to bond with their infants, and denying the infants additional opportunities to thrive. With conventional care, neonates are cared for by nurses and are often placed in an incubator, with little human contact until they become stable, or often until they are mature enough to sustain their temperature outside the incubator on their own. However, with Kangaroo care it may be

possible for stable and some slightly unstable premature infants to have the benefits of contact with their mothers before they are able to completely control their own temperatures.

The aim of this thesis is to discuss the benefits and risks of providing Kangaroo Care in the Neonatal Intensive Care Unit (NICU) setting, and to develop a practice guideline for implementation of Kangaroo Care. To gain adequate resources the researcher searched the following databases: Cochrane, MEDLINE, CINAHL, Proquest Nursing and Allied Health Source, Academic Search Complete, and HealthSource Nursing for the following terms: Kangaroo Care, or skin to skin contact, or Kangaroo Mother Care and infants, premature infants, prematurity, term, or neonates for full text research articles. These articles were read, evaluated, and the significant results were placed in a synthesis table. From the synthesis table, the researcher created a guideline for practice that can be implemented in hospitals with Neonatal Intensive Care Units (NICUs).

The primary focus of the Neonatal Intensive Care Unit (NICU) has been on the physiologic support of premature and sick infants' respiratory, cardiac, gastrointestinal, renal, immune, endocrine, and integumentary systems (Aucott, Donohue, Atkins, & Allen, 2002). However, "outcomes studies have consistently found that preterm children have a higher rate than full term controls of major disabilities, sensory impairments and the high prevalence/low severity disorders that lead to school and behavioral problems." (Aucott, Donohue, Atkins, & Allen, 2002, p. 298). According to Bowden, Greenberg, and Donaldson, neurodevelopmental care involves more than simply following protocol, and focuses on the relationship-based care with systematic review of the infant's cues and

adapting the care environment to facilitate the infant's needs (2000). Infants who receive developmental care, including Kangaroo Care, have been shown to have a shorter duration of mechanical ventilation, less severe intraventricular hemorrhages, better weight gain, improved physiologic stability, and a shorter hospitalization than those who did not receive developmental care (2000).

Kangaroo care is a component of developmental care and has been proven to have numerous benefits for both the mother and the preterm infant. Benefits to the infant include improving infant state organization, thermal regulation, respiratory patterns, oxygen saturation, as well as reducing apnea and bradycardia spells, functioning as an analgesic during procedures, improving weight gain, and shortening hospital stay (Feldman, Eidelman, Sirota, & Weller, 2002). It has also been shown to have maternal benefits such as improved milk supply and improved sense of competence, as well as facilitation of the maternal-infant attachment process (Feldman et al., 2002).

The results of 20 published trials on Kangaroo Care are included in table one. The results of these trials along with previous articles published serve as a basis for the practice of Kangaroo Care in the NICU environment. The results of all of the trials outlined in Table 1 were considered prior to development of a Kangaroo Care guideline, and additional resources were included while developing the guideline. All resources were peer reviewed articles published in professional nursing journals and were written by experts in the field of neonatal care.

Although many of the trials included small sample sizes and may have had inconclusive results, no trials showed any adverse effects for either the parents or the infants as a result of the Kangaroo Care intervention. All articles either showed a

potential benefit of Kangaroo Care for the parent, infant, or both or showed that there was no difference in outcomes for the infant. However, all studies that were inconclusive as far as benefits for the infant, listed the possibility of maternal benefits, as well as the possibility of increased patient satisfaction scores, and listed no adverse effects for the infants.

Table 1			
Reference:	Study Type	Sample Size/Type	Major Findings/ Conclusion
Dombrowski & Anderson, 2000	Case Study	1 set of premature twins and their adolescent parents	KC is feasible with twins and may decrease potential risk factors for adolescent parents. Both parents demonstrated attachment behaviors with the infants, and displayed self confidence after participating in KC
Erlandsson, Dsilna, Fagerberg, & Christensson, 2007	Randomized-controlled trial	Full term infants of mothers who underwent cesarean delivery. N=15 KC with father vs. N=14 control.	Infants held skin to skin cried significantly less than those wrapped in blankets and placed in crib, infants cared for skin to skin became calm and reached a drowsy state in 60 minutes vs. 110 minutes for infants in cribs. KC seems to facilitate coordination of prefeeding behavior.
Feldman, Weller, Sirota, & Eidelman, 2003. (Testing a family intervention...)	Comparison study of matched infants	146 preterm infants, with a mean birth weight of 1270 g. Mean gestational age 30.65 weeks N=73 KC vs. N=73 control	Following KC, mothers and fathers were more sensitive and less intrusive during interaction, infants showed less negative emotionality than controls. KC families demonstrated higher parent-infant reciprocity. Families' later relational style was more cohesive and less intrusive. KC is an easy cost effective method that contributes to the parent preterm infant relationship and appears to have no negative side effects.
Feldman, Eidelman, Sirota, & Weller, 2002 (Comparison of Skin-to-Skin...)	Comparison study of matched infants	146 preterm infants, with a mean birth weight of 1270 g. Mean gestational age 30.65 weeks N=73 KC vs. N=73 controls	Mothers who provided KC were less depressed, and perceived their infants as less abnormal during the hospitalization period. Parents from the KC group provided a more sensitive and appropriately stimulating home environment, and were more sensitive, warm, adaptive and resourceful at the 6-month visit.
Feldman, Weller, Sirota, & Eidelman, 2002(Skin-to-Skin contact(Kangaroo Care) promotes...)	Comparison study of matched infants	146 preterm infants, with a mean birth weight of 1270 g. Mean GA30.65 weeks N=73 KC vs. N=73 controls	There was a better organization of sleep-wake states following KC.
Ferber & Makhoul, 2004	Randomized-controlled trial.	Term infants delivered vaginally. N= 25 KC group, received 60 minutes KC after birth, vs. N=23 control group, were taken to nursery 5- 10 minutes after birth.	KC infants spent more time in sleep states and less time in transitional, crying, fussy, and alert states than controls. KC infants also spent more time in quiet sleep. KC infants exhibited more flexed movements and postures and less extended postures than controls. There were no apparent negative effects of KC.
Hake-Brooks, & Anderson, 2008	Randomized-controlled trial	66 mothers and preterm infants GA 32-36 weeks, Birthweight 1300-3000 g. N= 36 KC vs. N=30 control	KC dyads exhibited greater breastfeeding exclusivity than controls for the first 18 months of life. KC dyads breastfed significantly longer than control dyads.
Ibe, et al., 2004	Experimental study with crossover	Low birthweight (1200-1999g.) infants, mean	All infants had significantly higher temperatures during KC than when in incubator. The risk of

	design.	gestational age 33 weeks. N= 13	having an episode of hypothermia was reduced by >90 percent when nursed in KC as compared to conventional care. Infants had greater thermal stability during KC. KMC is an adequate low cost alternative for maintaining warmth in situations where thermal regulation equipment is unreliable.
Johnson, 2007	Qualitative naturalistic inquiry.	Eighteen mothers who had participated in kangaroo care in a Level III NICU in Delaware.	Mothers reported that being allowed to participate in kangaroo care helped them to feel needed by their infant; they later described their role as important in caring for their infant. Mothers also described KC as a heartwarming experience, and stated that they had an increase in confidence after participating in KC.
Johnston, et al., 2008	Single blind randomized crossover design	61 Preterm neonates (GA 28 0/7- 31 6/7) in three Level III NICUs in Canada	The time to return to baseline heart rate following heel lance was significantly shorter during KC as compared to control. Average oxygen saturations were significantly higher at 60 and 90 seconds post heel lance for KC infants. KC resulted in lower pain scores after a painful procedure in preterm neonates.
Kashaninia, Sajedi, Rahgozar, & Noghabi, 2008	Randomized-controlled trial	100 full term neonates undergoing injection N= 50 KC vs. N= 50 control	There was significantly less pain expression, using the Neonatal Infant Pain Scale (NIPS) in the KC group after a minor painful procedure in full term neonates.
Ludington-Hoe, et al., 2006	Case study	Two sets of premature twins held in shared KC for 1.5 hours	Breast temperature can change independently of each other but not independently of the infant. When the infants' temperature dropped, the breast temperature increased to warm the infant and when the infants' temperature rose the breast temperature dropped.
Ludington-Hoe, 2005	Cross over design	23 premature infants	Heart rate and crying responses to pain were significantly decreased in infants who received 3 hours of KC before heel stick.
Moran, 1999	Case study	32 week 1953 gram infant whose parents participated in KC from 4 hours post birth	KC proved to be a satisfying experience for this family.
Ohgi, et al., 2002	Historical control study	Low birthweight preterm infants N=26 KC vs. N= 27 comparison group	At 40 weeks corrected age KC infants were more alert, responsive, and less fussy and irritable than infants who had not received KC. KC promoted neonatal behavioral organization and enhanced developmental outcomes over the first year of life in low birthweight infants.
Parker, & Anderson, 2002.	Case study	917 g, 27 week gestational age infant who had KC by her adoptive parents	Although critically ill and on a high frequency ventilator, the infant was clinically stable during initial KC and KC was offered for two hours on each subsequent day. Infant had no periods of instability during KC. KC facilitated bonding with adoptive parents.
Smith, 2003	Experimental crossover design	14 very low birth weight intubated premature infants on stable or weaning ventilator settings.	There was no difference in heart rate, beat to beat interval, variability for infants receiving KC compared to receiving conventional care.
Sonthimer, Fischer, & Bueh, 2004.	Pilot study	31 stable preterm and term infants who were transported in the kangaroo care position.	Heart rate, respiratory rate, and oxygen saturation remained stable during transport. No crying or agitated behavior was observed. Parents reported feeling comfortable, safe, and were appreciative of being allowed to participate in the transport. It was reported that KC transport is a cost effective alternative, which may be safer for stable infants due to being restrained in the KC position as opposed to unrestrained in an incubator.

Tornhage, Stuge, Lindberg, & Serenius, 1999	Pilot study	Convenience sample 17 low birthweight premature infants	KC was well tolerated, as was nasogastric feeding during KC.
Walters, et al., 2007	Pilot Study	9 full term infants	No infants became hypothermic during KC, 8 of the 9 infants spontaneously and independently moved to the breast and latched.
Key: GA= Gestational age, KC= Kangaroo Care, N= sample size			

According to Ludington-Hoe, Morgan, and Abouelfettoh, Kangaroo Care has been proven to provide the following benefits for infants of 30 weeks or more postmenstrual age: Cardiorespiratory stability, stable oxygen saturations, decreased desaturation events, and a reduction in apnea (2008). Kangaroo Care also results in increased temperature stability, reduced stress as evidenced by lower cortisol levels, increased weight gain and head circumference, decreased incidence of nosocomial infections, increased sleep organization, reduced crying, and has an analgesic effect (Ludington-Hoe, Morgan, & Abouelfettoh 2008). There are also benefits for the parents as a result of Kangaroo care. KC has been proven to increase maternal milk supply, decrease maternal and paternal anxiety, increase parental satisfaction, and increase attachment to the infant (DiMenna, 2006).

However, despite the many proven benefits of Kangaroo Care, it is not always routinely implemented in many NICUs, and many parents may not even be offered the opportunity to participate in Kangaroo Care unless they specifically ask. According to DiMenna, in a survey of 215 NICUs in the United States, only 45 percent offered KC to parents of infants who were on a ventilator, while 73 percent offered parents to participate in KC with infants who were not on a ventilator (2006). Reasons that were given for not offering KC included, parent not being aware of benefits and therefore not asking to participate, not enough support from staff members, and concerns for infant safety (DiMenna, 2006).

Although an infant's safety is always a primary concern with the implementation of Kangaroo care, with adequate protocols, multidisciplinary collaboration, and nursing supervision of Kangaroo Care, many infants can benefit from this intervention. Lack of knowledge of the benefits by the parents is not a good reason to avoid implementing Kangaroo Care; this should be something that parents are educated about in the very beginning of their infant's hospitalization, and not something that they should have to ask for after they learn about it from other sources. After all, what better sources are there than neonatal nurses educated in the implementation of Kangaroo Care? Staff should also be educated about Kangaroo Care and should be provided with ongoing clinical education about this practice, so that they may become more informed and better able to provide support for the parents.

In order to implement Kangaroo Care, staff must have guidelines by which to determine which infants are good candidates for Kangaroo Care and when Kangaroo Care is not recommended. Infants who are deemed unable to participate in Kangaroo Care should routinely be reevaluated, as they may become candidates later in their hospitalization. If any parent wishes to participate in Kangaroo Care when Kangaroo Care is not recommended, there should be an in-depth discussion within the multidisciplinary team who must weigh the risks and benefits, and must then discuss the possible outcomes with the parents.

In general, infants who would be good candidates for Kangaroo Care are infants who have stable vital signs, who are on limited or no respiratory support, and who tolerate routine care without any distress. However, with careful planning it is possible to implement Kangaroo Care for infants who are on respiratory support and with healthcare

provider approval, even infants who are on a ventilator. According to Ludington-Hoe, Morgan, and Abouelfetoh, infants who are stable on a conventional mechanical ventilator, and who have been on the ventilator for more than 24 hours and are not actively weaning or needing increased ventilatory support are candidates for Kangaroo Care (2008). In order for an infant to be a candidate for Kangaroo Care, the infant must also be hemodynamically stable (DiMenna, 2006).

Although there is not sufficient research to recommend placing infants who are on a High Frequency Oscillatory Ventilator (HFOV) in the Kangaroo Care position, it is ultimately up to the provider of care to determine if this is an appropriate intervention. According to Kledzik, “parents have routinely and successfully held skin-to-skin infants with bilateral chest tubes, with multiple lines, and on ventilators, including HFOV” (2005, p. 7). However, the author cannot recommend placing an infant with any chest tubes, umbilical arterial lines, umbilical venous lines, other positional lines, vasoactive drips, or unstable ventilator setting (including HFOV) in the Kangaroo Care position without careful consideration and discussion of the multidisciplinary team (Kledzik, 2005).

There are some infants for which Kangaroo Care is absolutely contraindicated. These include infants who experience frequent bradycardia requiring stimulation, frequent apnea spells requiring stimulation, frequent desaturations requiring stimulation, and negative physiologic changes with hands on care that exceed normal vital sign parameters (Ludington-Hoe, Morgan, & Abouelfetoh, 2008). Other infants for whom Kangaroo Care is contraindicated include infants less than 27 weeks gestation within the first week of life who require a humidified incubator, due to the possibility of insensible

water loss, as well as infants with a gastroschisis, oomphalocele, or myelomeningocele, sepsis, infants with hemodynamic instability, and new post operative infants, due to the possibility of overwhelming pain with stimulation (DiMenna, 2006). Other contraindications for Kangaroo Care are rapidly rising bilirubin despite phototherapy, or intensive phototherapy, and total serum bilirubin in the high-risk zone or at the exchange level for that institution (Ludington-Hoe, Morgan, & Abouelfettoh, 2008).

After assessing infant readiness for Kangaroo Care, it is important to determine whether the parent is ready for Kangaroo Care. This includes cognitive, emotional, and physical readiness for Kangaroo Care. The parent should have an understanding of Kangaroo Care, and be able to verbalize the risks and benefits for their child. The parent should also express an emotional readiness for Kangaroo Care. KC should not be initiated if the parent is anxious or afraid of holding the infant, and the parents should not be coerced into participating in KC if they do not wish to. The parents must also be physically ready to participate in KC. They must have clean skin, be free of any rashes, lesions, and must not have an upper respiratory infection or any other communicable illness. The parent should also wear a shirt or blouse that opens completely in the front, or may choose to wear a patient gown with the closures in the front.

The infant may be transferred to the KC position using one of two transfer techniques. The sitting transfer technique is appropriate if the infant has multiple lines that must remain secured, or if the infant is on ventilatory support such as nasal continuous positive airway pressure (CPAP) or on a ventilator, or if the mother prefers to have the infant placed on her chest rather than moving and sitting down while holding the infant (Ludington-Hoe, Morgan, & Abouelfettoh, 2008). When using the sitting transfer,

the nurse moves the infant from the incubator in a flexed position, ensuring that all lines and tubes are secure, and places the infant on the reclining mother's breast. Infants can also be transferred to the KC position by a standing transfer. Standing transfer is appropriate if the monitoring equipment is minimal and there are minimal lines which are easily manageable, and the mother and nurse feel comfortable with moving the infant on the mother's chest. With this technique, the mother picks the infant up from the incubator straight to her chest, while the nurse is managing all tubes, lines, and monitoring equipment, and moves to the chair and sits down without ever removing the infant from her chest.

In addition to performing appropriate transfer techniques, the nurse must be careful to assure proper positioning of the infant. The head and neck must be in a neutral position, because hyperflexion and hyperextension can result in obstruction of the airway (Ludington-Hoe, Morgan, & Abouelfetoh, 2008). The full ventral surface of the infant should be in skin-to-skin contact with the mother to obtain the full benefit of KC, and the infant's extremities should be positioned in a flexor position with the hands close to the mouth (Ludington-Hoe, Morgan, & Abouelfetoh, 2008). Allow the infant's head to be turned to the side to hear the mother's heartbeat, cover the infant with a blanket, and have the mother cross her arms over the infant's back to provide containment for the infant (DiMenna, 2006).

After ensuring proper positioning of the infant in the KC position, it is important to ensure that the mother is comfortable. The nurse must then make sure that all lines are secured and tape the IV and ventilator tubing to either the mother or the mother's chair. The nurse may offer the mother a mirror so that the mother can view the infant's face and

may offer to take pictures if the parents wish for pictures to be taken. The nurse should continuously monitor the infant for the first fifteen to twenty minutes while the infant is adjusting from the transfer. The nurse must assure that the infant's vital signs have stabilized, and then may continue with monitoring per hospital protocol.

It is important to monitor the infant for signs of intolerance throughout the KC session. Signs of intolerance are the same as those for overstimulation or stress in the neonate, and include change in heart rate or breathing from baseline at rest, increased oxygen demands, color changes, tremors, yawning, sneezing, hypotonia or hypertonia, restlessness, hyperalertness, grimacing, crying, and averted gaze (Kledzik, 2005). When the infant shows any signs of intolerance or the mother expresses the desire to end the KC session, the infant must be transferred using either the sitting transfer or standing transfer technique and the nurse should reassess the infant while in the incubator. Documentation of the KC session should include vital signs before, during, and after KC as well as tolerance of the KC session. The nurse should also document how long the session lasted, and assessments of the mother and the infant in regards to the KC session.

In conclusion, with the appropriate guidelines and monitoring, Kangaroo Care can be a beneficial practice for premature infants in the NICU setting. Advances in technology and medical practices have led to a greater ability to save the lives of premature infants; however, the interventions that must be employed to save the infants' lives may pose a threat to the long-term developmental outcomes of these infants (Aucott, Donohue, Atkins, & Allen, 2002). Therefore, it is important to implement developmental care, including Kangaroo Care, in order to improve the long-term outcomes of premature infants. Kangaroo Care, when properly implemented, has numerous physiologic benefits

for the infant as well as benefits for the mother, and may enhance the maternal-infant attachment. It is important for NICUs to implement Kangaroo Care protocols, so that all infants in the NICU may benefit from this practice. A guideline for the implementation of Kangaroo Care in the NICU environment is included on the next two pages and may serve as a template for the development of a neonatal Kangaroo Care protocol.

Columbus State University
Department of Nursing
Practice Guideline for Kangaroo Care

Desired outcomes:

- Maintain physiologic stability of the infant during Kangaroo Care session.
- Facilitate a maternal-infant bonding process.
- Promote sleep and brain development of the infant.

Equipment Needed:

- Receiving Blankets
- Adult sized patient gown
- Privacy screen or privacy curtain
- Reclining chair, or chair with footstool
- Hand mirror

Eligibility:

- Must be deemed eligible to participate by primary care provider.

Any infants with the following conditions are automatically ineligible to participate:

- Frequent bradycardia, apnea, or desaturations requiring stimulation.
- Infants with preoperative gastroschisis, oomphalocele, or myelomeningocele.
- Infants with hemodynamic instability.
- Infants with serum bilirubin at the exchange level, or intensive phototherapy.
- Infants whose parents have rashes, lesions, cold, flu, or acute illness.

Preparation:

- Ensure that parents are educated about the risks and benefits of KC.
- Collect equipment and prepare the environment and parent for transfer of the infant
- Parent must either be wearing a shirt or blouse that opens completely in the front or may wear a patient gown with closures in the front.
- Prepare infant for transfer: Assess vital signs and stability, perform any necessary procedures which would interfere with KC if performed later, change diaper and remove clothing, place infant in supine position and allow infant up to 10 minutes to recover before transfer.

Transfer:

- May use sitting or standing method for transfer.
- For intubated infants use an established protocol for the transport of intubated infants.
- Place infant upright skin-to-skin on parent's chest, either between the breasts or on one breast.

KC Positioning:

- Between or on mother's breast in an upright position.
- Mother should be reclined at a 30 to 45 degree angle above horizontal.
- Full ventral body contact of the infant with the mother should be ensured.
- Infant should maintain a flexed posture of the upper and lower extremities; hands should be near the infant's mouth.
- Head should be in a neutral position, ensure patent airway.
- Infant's head may be turned to the side so that ear is over the mother's heart and the mother may see the infant's face.
- If mother cannot see the infant's face, offer the mother a hand mirror so that she may view her infant.
- The mother's shirt should be closed over the infant, and a receiving blanket placed over the infant's back
- Have mother cross her arms over the infant's back to ensure containment.

Monitoring Vital Signs:

- Continue all routine monitoring equipment.
- Monitor infant's temperature before, during and after KC according to hospital protocol.
- Allow infant 15 to 20 minutes to stabilize after transfer.
- Continue KC for at least one hour if infant tolerates KC. Monitor for and document any signs of intolerance.

Transfer Back to Incubator;

- The infant should be transferred if it shows any signs of intolerance, or the mother desires to end the KC session.
- Transfer using either sitting or standing technique.
- Position the infant in the incubator.
- Reassess the infant after being placed in the incubator.
- Clean up around the bedside.

Documentation:

- Document vital signs before, during, and after KC.
- Document infant's sleep-wake cycle in relation to KC.
- Document KC start and stop times and length of KC session.
- Document infant and parent tolerance of KC.

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